CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

1. A nanostructure, comprising:

a free-standing, helical semiconductor oxide nanostructure including a nanobelt having a substantially rectangular cross-section, wherein the nanobelt is about 5 nanometers to about 200 nanometers in width and about 3 nanometers to about 50 nanometers in height, and wherein the radius of the helical semiconductor oxide nanostructure is about 200 to 5000 nanometers.

2. The nanostructure of claim 1, wherein the semiconductor oxide is chosen from oxides of zinc, cadmium, mercury, gallium, indium, tellurium, germanium, tin, and lead.

3. The nanostructure of claim 1, wherein the semiconductor oxide is zinc oxide.

4. The nanostructure of claim 1, wherein the nanobelt is a single crystalline structure.

5. The nanostructure of claim 1, wherein the nanobelt is a polar surface dominated zinc oxide nanobelt.

6. The nanostructure of claim 1, wherein the nanobelt includes polarized ±(0001) facets.

7. The nanostructure of claim 1, wherein the nanobelt has a substantially uniform width along the length of the free-standing helical semiconductor oxide nanostructure.

8. The nanostructure of claim 1, wherein the semiconductor oxide is zinc oxide, wherein the nanobelt has a top ±(0001) surface, bottom ±(0001) surface, a right side $\pm(10\bar{1}0)$ surface, and a left side $\pm(10\bar{1}0)$ surface.

9. The nanostructure of claim 1, wherein the semiconductor oxide is zinc oxide, wherein the nanobelt is described by characteristics selected from an interior (0001)-Zn surface and an exterior $(000\bar{1})$-O surface, and an interior surface $(000\bar{1})$-O and exterior surface (0001)-Zn.

10. A nanostructure comprising:

a free-standing semiconductor oxide nanoring, wherein the nanoring has a radius of about 500 to 10,000 nanometers, a height of about 5 to 2000 nanometers, and a width of about 50 to 7500 nanometers.

11. The nanostructure of claim 10, wherein the semiconductor is chosen from ZnS, GaN, CdSe, and oxides of zinc, cadmium, gallium, indium, tin, lead, and, and combinations thereof.

12. The nanostructure of claim 10, wherein the semiconductor oxide is zinc oxide.

13. The nanostructure of claim 12, wherein the nanoring includes a nanobelt having a substantially rectangular cross-section, wherein the nanobelt is about 5 nanometers to about 200 nanometers in width and about 3 nanometers to about 50 nanometers in height.

14. The nanostructure of claim 13, wherein the nanoring includes about 1 to 250 loops of the nanobelt.

15. The nanostructure of claim 13, wherein the semiconductor oxide is zinc oxide, and wherein the nanobelt includes a top $\pm(0001)$ surface, a bottom $\pm(0001)$ surface, a right side $\pm(1\bar{2}10)$ surface, and a left side $\pm(1\bar{2}10)$ surface.

16. The nanostructure of claim 13, wherein the semiconductor oxide is zinc oxide, wherein the nanobelt has an interior (0001)-Zn surface and an exterior $\pm(000\bar{1})$-O surface.

17. The nanostructure of claim 11, wherein the nanoring is a single crystalline structure.

18. A method of preparing nanostructures comprising:

exposing a homogeneous metal oxide powder mixture to thermal conditions of about 900 to 1600 °C at a pressure of about 10^{-3} to 10^{-2} torr for about 5 to 100 minutes;

flowing an inert gas over the homogeneous metal oxide powder mixture; and

forming a free-standing semiconductor oxide nanostructure via a condensation reaction at a pressure of about 50 to 800 torr and at thermal conditions of about 100 to 700 °C, each of the free-standing semiconductor oxide nanostructures having a substantially rectangular cross-section.

19. The method of claim 18, wherein the homogeneous metal oxide powder mixture is selected from zinc oxide, lithium oxide, lithium carbonate, indium oxide, gallium oxide, and combinations thereof.

20. The method of claim 18, wherein the free-standing semiconductor oxide nanostructure is a free-standing, helical semiconductor oxide nanostructure including a nanobelt having a substantially rectangular cross-section, wherein the nanobelt is about 5 nanometers to about 200 nanometers in width and about 3 nanometers to about 50 nanometers in height, and wherein the radius of the helical semiconductor oxide nanostructure is about 200 to 5000 nanometers.

21. The method of claim 18, wherein the free-standing semiconductor oxide nanostructure is a free-standing semiconductor oxide nanoring, wherein the nanoring has a radius of about 500 to 10,000 nanometers, a height of about 5 to 2000 nanometers, and a width of about 50 to 7500 nanometers.